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SALVAGE ON THE TILLAMOOK BURN AS AFFECTED BY INSECT ACTIVITY

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TABLE OF CONTENTS

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INTRODUCTION

Approximately 4 years have elapsed since 10-1/4 billion board feet of timber was killed by the Tillamook fire of 1933. Soon after the fire the owners of the timber began to make plans for salvage. Taking into consideration the accumulated experience of loggers who had cut fire-killed timber in the Pacific Northwest, they estimated that large-scale salvage operations could be conducted profitably for 6 or 7 years. Now, when more than half of the salvaging should be completed, it is well to consider what has been done, what remains to be done, and what factors are limiting salvage.

Since no plan had previously been made to liquidate the large timber resources on this area, there was some delay at first because of the considerable organization that was necessary before operations could begin. One of the first steps was to obtain a special allotment of cut under the Lumber Code Authority of NRA. During the initial period of actual operations, beginning in November 1934, labor disturbances caused considerable curtailment of operating schedule; however, approximately 500 million board feet, or 4.9 per cent, of the burned timber had been salvaged by August 1937. The timber salvaged thus far includes about 1 million board feet of hemlock, which is 0.06 per cent of

the total of that species burned by the fire. Salvage of hemlock was halted in April 1936 as being no longer practical, because of advanced decay and insect activity. Some western red cedar is being salvaged, and it is probable that a few of the larger Sitka spruce will also be taken. These two species are only minor constituents of the entire stand of burned timber. Consequently, it is apparent that the values that can be realized in the future depend almost entirely upon the rate of deterioration of the remaining Douglas fir.

Beal, Kimmey, and Rapraeger, (1) in their study of deterioration of fire-killed Douglas fir in the Northwest, concluded that, "generally speaking, Douglas fir trees less than 2 feet in diameter at breast height should be logged the first year following the fire, and those approximately 3 feet in diameter before the fifth year. Trees 5 feet in diameter usually should be salvaged by the seventh year. Trees more than 5 feet in diameter occasionally yield lumber logs 15 years after fire." In some cases, salvage has been continued for periods longer than those indicated, but most of these have been truck-logging operations on a relatively limited scale.

No complete classification of the tree sizes on the Tillamook Burn has been made. Table I gives the available information relative to the sizes of the Douglas fir. On the basis of size alone, perhaps 20 per cent of the burned timber is unusable or is in the marginal-value class at the present time. Salvage loggers realized from the beginning that size is a factor limiting salvage. For

practical reasons, however, it was necessary to take out the timber just as it was encountered rather than remove the smaller trees first. It is probable that in the near future economic considerations will necessitate a diameter selection.

TABLE NO. I (2)

Board-foot Volume of Douglas Fir

16 Inches or More in Diameter Killed by Tillamook Fire

Class of Tree	Total Volume in MBM
Second growth:	
16 inches to 20 inches d. b. h.	85,536
20 inches to 40 inches d. b. h.	71,880
Old growth:	
20 inches to 40 inches d. b. h.	1,847,989
40 inches or more d. b. h.	6,081,506
TOTAL	8,086,911

The agents primarily responsible for the deterioration of dead Douglas fir are insects and fungi. A field study has been made to determine how much damage insects have done, individually and collectively, and what damage they are likely to do in the immediate future. Although the findings apply specifically to the Tillamook Burn, it is believed that much of the information applies in general to salvage on other burns in the Douglas fir region.

From the standpoint of recovery of merchantable values, relatively few of the many insects attacking fire-killed Douglas fir are of primary concern. In general, these fall into the following

three groups, characterized by distinctive feeding habits: (1) Bark feeders, or these that bore between the bark and the wood; (2) sapwood feeders; and (3) heartwood feeders.

Bark Feeders

The inner bark is a highly nutritious layer attractive to many insects, particularly during the first few years after the death of a tree. Insects that spend their entire existence in this zone do not destroy an appreciable amount of wood but do aid in loosening the bark, causing it to become a hazard to fallers. They also introduce wood-staining fungi. Most of the wood borers, both sapwood and heartwood feeders, spend their early life between the bark and the wood, and at this time are true bark feeders.

The Douglas fir beetle (Dendroctonus pseudotsugae Hopk.), a species native to the Douglas fir region, is the most abundant of the bark feeders in fire-killed Douglas fir. In the fall of 1933 many of the dead trees on the Tillamook Burn were attacked by this beetle; during the summer of 1934 still greater numbers were attacked, and by the end of that year nearly all of the dead trees were infested by at least a few of the beetles. The characteristic feeding tunnels (Fig. 1) between the bark and the wood were one of the first factors contributing toward the gradual loosening of the bark. Wood-staining fungi introduced by the Douglas fir beetle caused much of the initial degrade of the sapwood.

Perhaps of greater interest to the timber owners is the damage done by this insect to adjacent green timber and particularly

Figure 1

Inner bark surface showing galleries of the Douglas fir beetle (Dendroctonus pseudotsugae) X $\frac{1}{2}$.

to the large unburned block of trees within the borders of the Burn. A multitude of beetles emerged from dead trees in the spring of 1935; since trees killed in 1933 were no longer attractive to them, they attacked and killed groups of healthy trees, thus supplementing the original damage caused by fire (3). This infestation subsided in 1936 because the bark beetles were unable to maintain themselves for long in green timber. By that time, however, many thousands of trees had been killed.

As is usual around the edges of large burns, numerous scorched trees have continued to die since the fire, mainly as the result of Douglas fir beetle attacks. Present evidence of this type of destruction is a fringe of recently killed timber bordering the Burn.

Another insect that was common in 1934 and 1935 between the bark and the wood of Douglas fir killed in the Tillamook fire was the fir flatheaded borer (Melanophila drummondi Kby.). While it aided the Douglas fir beetle in killing scorched trees and loosening bark of dead ones, it did not kill groups of unburned, green trees.

The appearance of both the larvae of the fir flatheaded borer and their mines is distinctive (Fig. 2). The head end of the larva is enlarged and flattened. The galleries, which persist on the inner bark surface many years after the insects have left, are packed with granular material called frass. The crescent-like arrangement of this frass and the fact that the galleries do not score the wood are characteristics that aid in distinguishing between the work of the fir flatheaded borer and that of the wood-borers.

Figure 2

Inner bark surface showing galleries and larvae of the fir flatheaded borer (Melanophila drummondi) X 1.

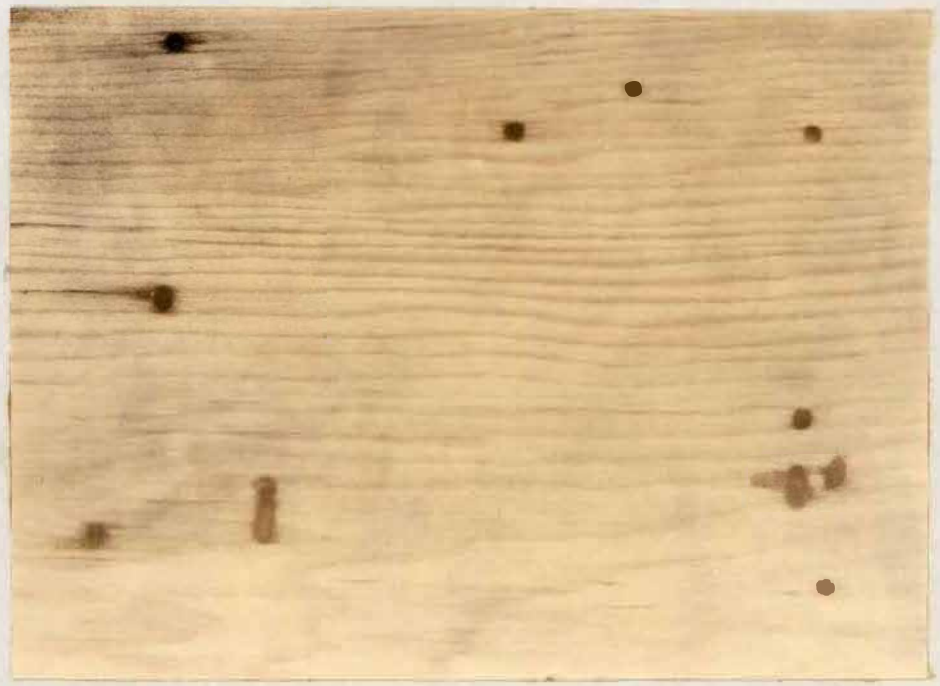
Sapwood Borers

Sapwood of a fire-killed tree very rapidly loses its merchantable value through the combined attacks of fungi and insects. Even in the first year the sapwood is degraded to a considerable extent, by the second year little of it is usable, and at the end of three years it is a total loss. Insect species that live in the decaying sapwood are multitudinous, but only a few get into the trees soon enough to take part in the destruction of commercial values. The decayed sapwood harbors certain heartwood borers during their early life.

In the fall of 1933, when the smoke from the Tillamook fire had hardly cleared away, great numbers of minute shiny beetles known as pinhole borers or ambrosia beetles began to attack the burned trees. These insects were the first to enter the wood of the fire-killed trees. Pinhole borers rapidly increased their activities during 1934. They decreased in 1935 but a few were still present in 1936, chiefly in trees that had died since the fire.

There are several different kinds of pinhole borers that attack fire-killed Douglas fir, but their appearance and habits are so similar that they may be considered as a group. Usually each pair of beetles constructs a branched gallery in the sapwood, a gallery marked at its entrance by a pile of conspicuous white boring dust. These egg tunnels, called "pinholes", are 1/16 inch or less in diameter (Fig. 3). During the summer months blue stain develops rapidly along the galleries, causing them to turn very dark within a few weeks after attack.

Figure 3



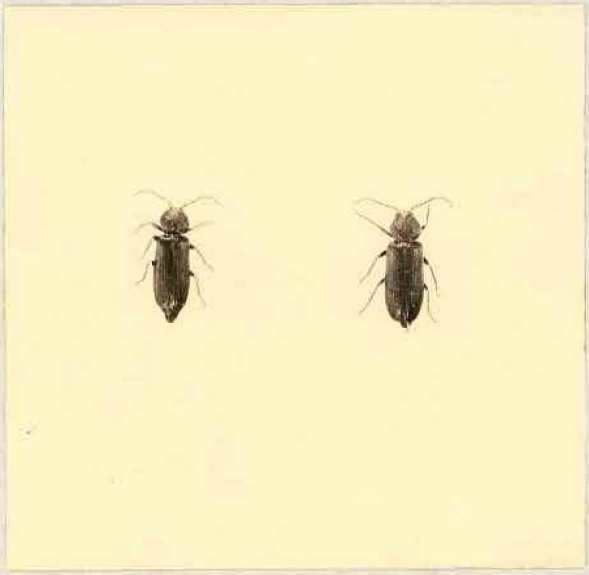
"Pinholes" in sapwood of fire-killed Douglas fir X 1.

The work of pinhole borers has an important bearing on the salvage of burned timber only for the first year or two after a fire, while the sapwood is still usable. Even when pinholes are abundant, if the wood is otherwise sound their presence does not cause a total loss of sapwood; however, the holes and the accompanying blue stain do degrade any clear lumber that is cut from infested trees. Operators on the Tillamook Burn did not experience much loss from this source for the reason that by the time extensive operations were begun deterioration from rot and from the work of other insects had rendered most of the sapwood practically useless.

A great many borers attacking dead Douglas fir fall into the category of sapwood borers or "sapworms". The one most commonly referred to by this name is Asemum atrum Esch. This insect began to attack dead trees on the Tillamook Burn in the spring of 1934, and has gradually increased in numbers until now it can be found in the sapwood of a majority of the trees. It has entered the heartwood of few trees except the very smallest, and consequently has done no material damage to merchantable timber.

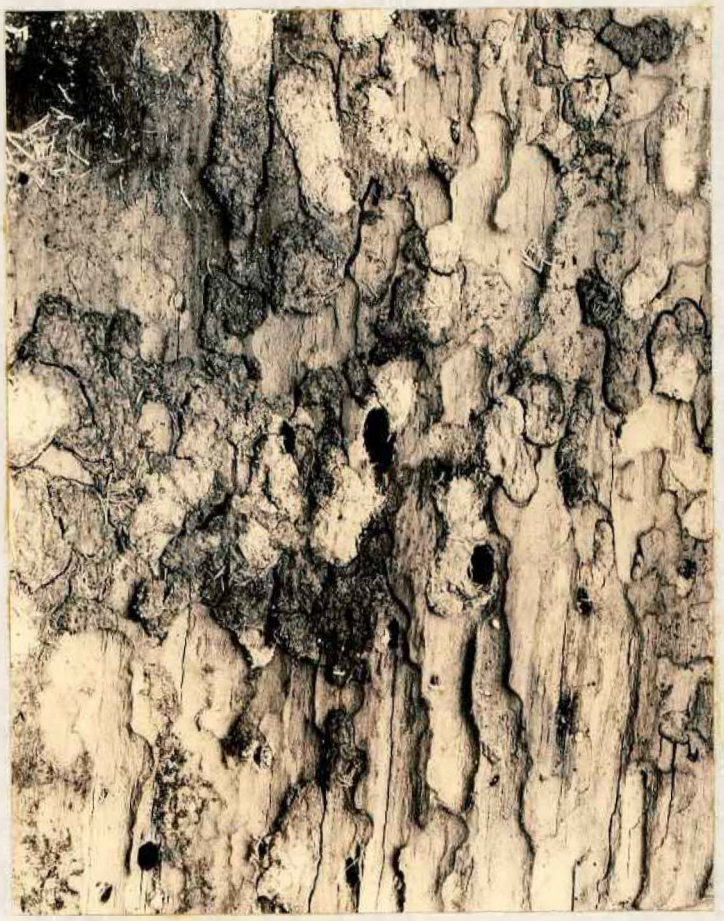
Contrary to common belief, these "sapworms" do not develop into the very large borers that later cause marked destruction of heartwood. Upon attaining a length of about 1 inch the Asemum larvae change to black beetles (Fig. 4A), approximately 3/4 inch long, which emerge in the spring and lay their eggs either in the same or in other dead trees. One year is required for development from egg to adult. The larvae spend their early life between bark and wood (Fig. 4B), later extending their galleries into the sapwood. Since the same trees are attacked year after year, the

Figure 4A



Adults of the sapwood borer (Asemum atrum) X 1.

Figure 4B



Wood surface showing galleries of the sapwood borer

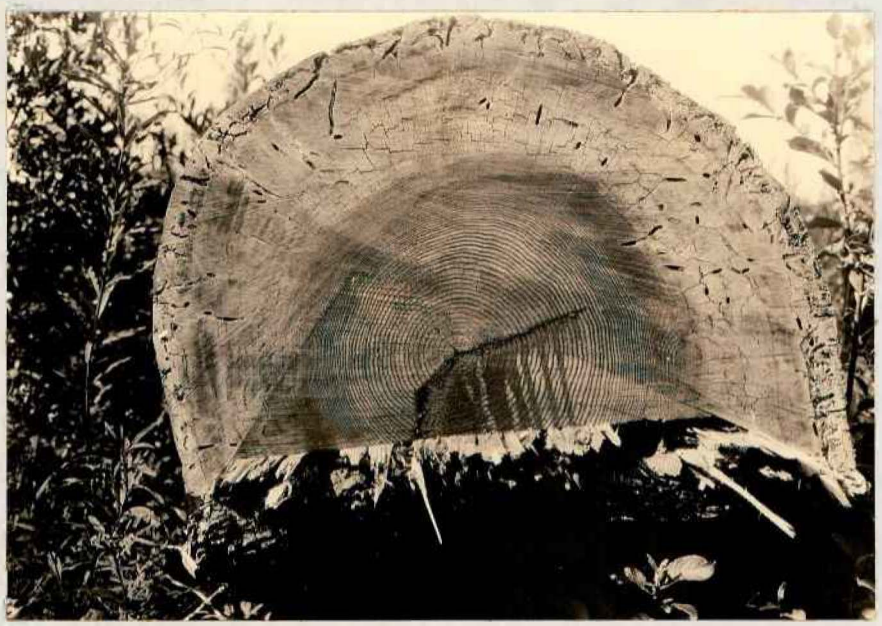
(Asemum atrum) X 1.

sapwood is gradually eaten away; consequently, successive generations of larvae extend their galleries deeper and deeper into the heartwood. In general, the smaller the tree, the sooner the heartwood is affected. Usually the basal 20 to 40 feet of a tree is preferred, owing perhaps to certain moisture requirements of the insects. Figure 4C shows typical work of this insect in a tree that had been killed by a fire 12 years previously. At the time the picture was taken the borers had penetrated about 8 inches into the heartwood and were still very abundant. This insect works slowly and often is outdistanced by other borers, but its abundance makes it a factor of importance.

Criocephalus productus Lec., a beetle that looks much like a large Asemum in both the larval and the adult stage (Fig. 5A), is likewise commonly known as a "sapworm". Heretofore Criocephalus has not been considered very important in salvage operations, but during the summer of 1936 and again in 1937 certain areas on the Tillamook Burn were found to be rather heavily infested by it. Infestation is localized in stands of uniformly small timber. Figure 5B, a photograph of a partial cross-section taken 40 feet above the base of a tree 60 inches in diameter at stump height, shows galleries of this borer penetrating 4 inches into the heartwood. As a usual thing the infested trees are smaller than the example shown. At the present time this insect is the only one causing appreciable deterioration of heartwood on the Tillamook Burn.

Often Criocephalus adults are attracted to burned trees before the trees have ceased to smolder. Larval development is much as in Asemum except that Criocephalus requires 2 or more years to complete

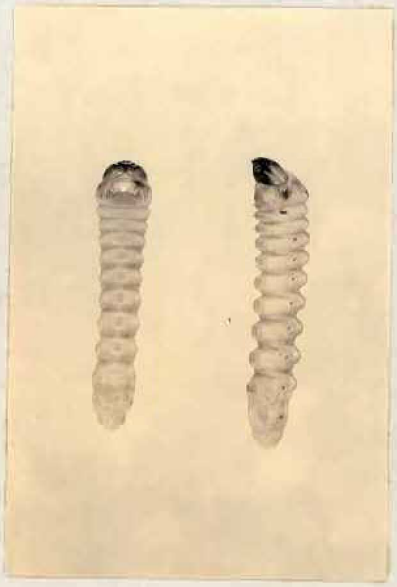
Figure 4C

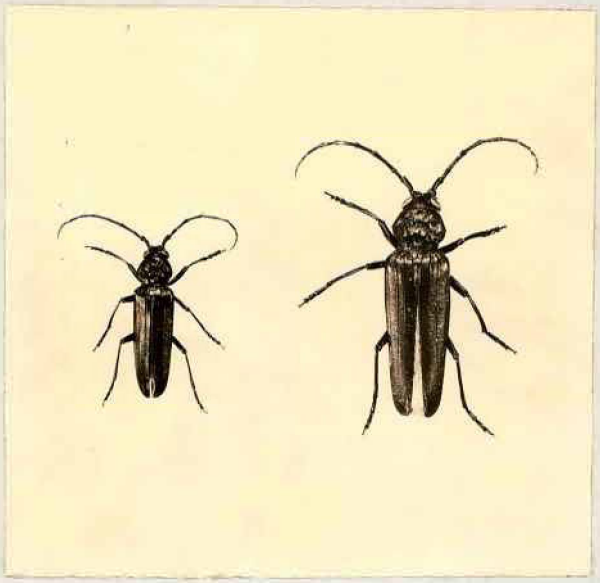


Basal section on 12-year old burn, showing mines of

Asemum atrum X 1/10.

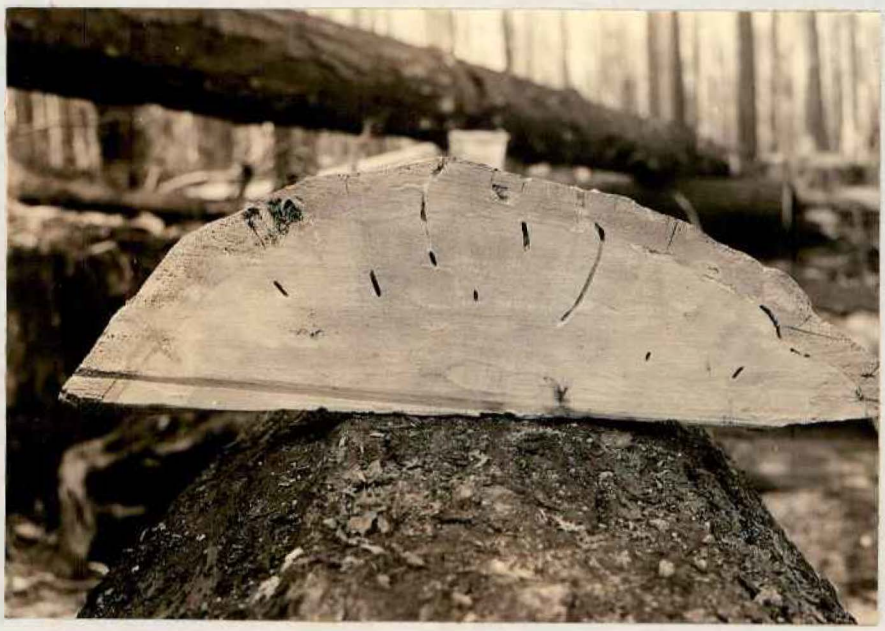
Figure 5A





Larvae and adults of Criocephalus productus X 1.

Figure 5B



Section of tree killed by the Tillamook fire, showing larval galleries of Criocephalus productus, X 1/8.

its life cycle. The galleries at first score both the inner bark surface and the outer surface of the sapwood; later they extend into the sapwood and finally into the heartwood. Coarse fibrous frass and the large average size of the tunnels are characters that aid in distinguishing the work of Criocephalus from that of Asemum. This distinction requires close observation and a certain amount of experience.

Although Criocephalus is less plentiful than some of the other borers, it or its work can be found on almost all burns in the coastal Douglas fir belt. It prefers small trees and the tops of large trees, and only occasionally attacks the merchantable portions of large trees. Presumably its larval activity is greatest during the third or fourth year after trees are killed, although this point has not been definitely established.

Heartwood Borers

The borers that attack sound heartwood are few in number of species but very important in the salvage of fire-killed Douglas fir. As previously stated, Asemum and Criocephalus at times bore into the heartwood. Of the others, only two are of interest to salvage operators in the Tillamook Burn.

In the Douglas fir region Platypus wilsoni Sw., one of the pinhole borers, already discussed as a sapwood-infesting group, extends its galleries into the heartwood. It prefers hemlock to Douglas fir and has caused much of the rapid deterioration of hemlock on the

Tillamook Burn. Late in the summer of 1936 it emerged in large numbers and found very little of its preferred host moist enough to attack. Apparently as a last resort, it attacked many Douglas firs on north slopes and along valley bottoms. For a time it appeared that this attack would have serious effect on salvage. The beetles, however, did not find conditions to their liking. Only a few extended their galleries as much as 1 inch into the heartwood, and these laid no eggs. Thus the damage was insignificant. Among more than 60 other burns examined during the last 3 years, no other instance was found of Platypus attacking Douglas fir.

Of most importance to the salvage logger is the damage done by Ergates spiculatus Lec. From the time when dead timber is entered by this insect prospects of successful salvage diminish very rapidly. Ergates larvae make their appearance from 5 to 7 years after trees are killed by fire. On some areas they soon become abundant. On others they increase very slowly, and in some instances they do not become numerous until the trees have almost completely rotted. An individual life cycle takes 3 or more years. Successive generations, however, usually continue to work in the same tree for a great many years.

Adults are large brown beetles about 2-1/2 inches long, rather commonly seen flying around lights during summer nights. The large larvae are commonly called "timber worms". Their work is so well known to all operators in the Douglas fir region that a description or illustration is unnecessary. (Both the adult and the larva are pictured in the article referred to in footnote 1.)

Of more than passing interest to salvage operators is the fact that snags on old burns near the Tillamook Burn are rather free from work of this borer. As an example, when last year the Grand Rapids Oregon Logging Company salvaged a few snags from the nearby Hamlet burn of 1896, only 10 per cent of the felled snags were observed to contain any Ergates work. No Ergates beetles have attacked any trees killed in the 1933 fire.

Summary of Present Situation

In brief, the situation on the Tillamook Burn is as follows: Deterioration is progressing at the average rate for burns in the Douglas fir region. Percentage of salvage material is lagging somewhat behind the original estimates. By April 1936, 0.06 per cent of the burned hemlock had been salvaged; since then, hemlock has been a total loss. Sapwood of Douglas fir had a zero value in the spring of 1935, except in trees that had died since the burn as a result of insect attacks. In Douglas firs of average to large size there has been practically no penetration of heartwood by insects. Certain areas, in fact, are more free of insect damage than might be expected at this time. On some areas where the timber is of small to medium size, Criocephalus borers have caused considerable damage, which may make it necessary within a short time to cut to a diameter limit. This insect is the only one causing an appreciable amount of deterioration of heartwood at present. In general, prospects for successful, large-scale salvage operations are good for several years to come.

A certain number of old snags and down trees on the Tillamook Burn that were dead long before that fire occurred have been logged and marketed; most of these have been wormy. Loggers should be careful in the future not to take out this type of material for two reasons: First, the logs are of low or negative value; and second, when mixed with logs from trees killed in 1933, which are still relatively sound, they may prejudice the market against all logs from the Tillamook Burn. The same is true of logs from certain small trees killed in 1933 that are already heavily infested with Criocephalus borers.

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